Division of Agricultural Sciences

UNIVERSITY OF CALIFORNIA

HANDLING SWEET CHERRIES FOR THE FRESH MARKET

W. C. MICKE • F. G. MITCHELL

CALIFORNIA AGRICULTURAL
Experiment Station
Extension Service

CIRCULAR 560
CAECAG 560 1–20 (1972)

Sweet cherries require careful management of temperature as well as maximum protection from rough handling. Once picked, they should be rapidly cooled to 32°F and kept at that temperature until they reach the consumer.

THIS CIRCULAR discusses details involved in the handling methods needed to deliver cherries to the market in good condition.

March, 1972

THE AUTHORS:

W. C. Micke is Extension Pomology Technologist, Davis.
F. G. Mitchell is Extension Pomologist, Marketing, Davis.

HANDLING SWEET CHERRIES FOR THE FRESH MARKET

No management program can improve the quality of sweet cherries after they are harvested, but careful management can prevent loss of quality. Poor management, however, can cause serious losses during the crop's journey from tree to fresh market. To complicate the problems in distribution, damage resulting from poor practices at one stage of handling may not become apparent until later in the marketing sequence. Sweet cherries are among the most perishable of California's stone fruits, and therefore must be constantly protected during handling—once quality is lost, it can never be regained.

Fruit deterioration can take three forms:

- Pathological .... rotting caused by microorganisms
- Physical .... damage from moisture loss, bruising, or other injury
- Physiological .... breakdown or self-destruction of fruit which often leads to over-ripening and senescence.

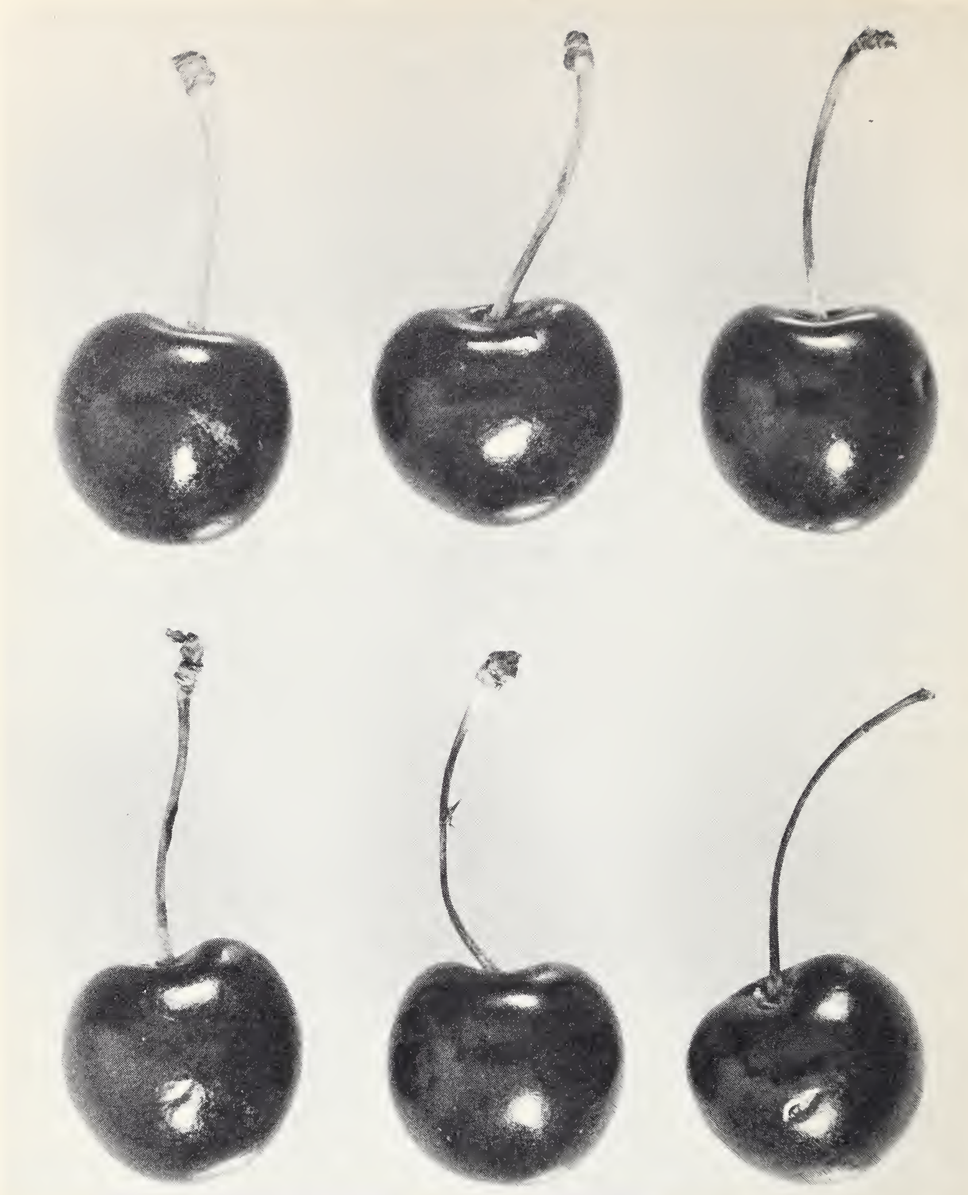
Pathological. Among the fungus diseases which can cause serious losses are brown rot (*Monilinia fructicola*), grey mold (*Botrytis cinerea*), and *Rhizopus* rot (*Rhizopus stolonifer*). To reduce loss from these organisms, proper handling—especially temperature management—is essential, and correct application of fungicides in the orchard and packing house can be vital. (For fungicide recommendations, consult the current "University of California Pest and Disease Control Program for Cherries.")

Physical. Physical injury is especially crucial in cherries because of the effect on fruit and stem appearance. Green, plump stems often indicate fruit freshness, and damaged stems can reduce consumer appeal. Cherries must be protected from moisture loss at all stages of handling, as such loss causes fruit and stems to shrivel, thus detracting from market appearance and reducing fruit weight. Additionally, when shrivel occurs after packing the fruit may loosen enough to move about in the container and bruise in transit.

Moisture loss is affected by several factors, including temperature, relative humidity, and air velocity. To minimize this loss, a 32°F holding temperature is best. (Care must be taken to avoid freezing the cherries.) However, even at these low temperatures serious moisture loss can occur unless a relative humidity of 90 to 95 per cent is maintained. The effect of air velocity on moisture loss is discussed in the section on cooling.

Most physical injuries such as bruising, skin punctures and cuts are caused by rough handling, which can be avoided. Injured areas on fruit—even minute ones—may serve as points of entry for rot organisms.

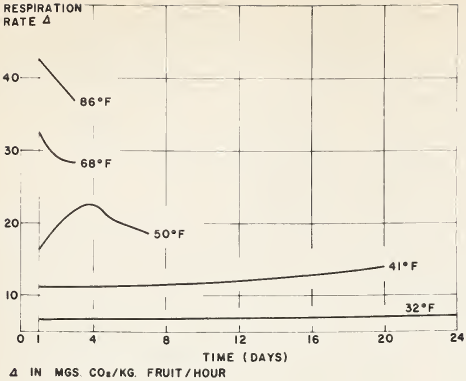
Physiological. Sweet cherries are alive, and the rate at which their physiological processes ("rate of living") occurs is higher than for most deciduous fruits. This physiological activity is largely temperature-dependent and increases 2 or 3 times with each 18°F of temperature rise. Thus, sweet cherries may deteriorate twice as fast at 50°F as at 32°F. At normal field temperatures activity is so high that fruit will begin to destroy itself soon after it is harvested. Therefore, prompt cooling of the fruit is essential if the potential shelf life of the cherry is to be realized.



Effect of moisture loss on stems. The top left fruit has a plump, bright stem while deterioration becomes progressively worse (left to right, top to bottom), with the lower right cherry showing a badly shriveled and darkened stem.

Cherries for fresh market are picked with the stem attached. Minimum damage to the cherry occurs if the stem (rather than the fruit) is held during picking. Care must be taken to avoid injuring the spur, which bears future years' fruit.

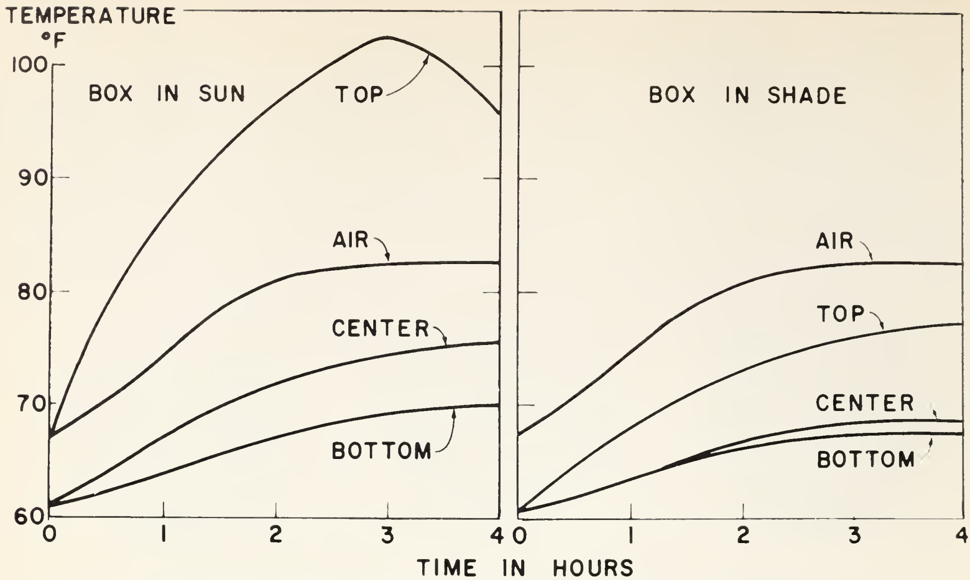
Fruit should be dumped gently to avoid brusing or damaging.



Effect of temperature on the respiration rate (a measure of the "rate of living") of Bing cherry—the higher the temperature the shorter the shelf life. Respiration readings at each temperature were discontinued with the first evidence of decay.

HANDLING FRUIT IN THE ORCHARD

For best flavor, cherries should be harvested as fully ripe as possible. Maturity is determined by color, and "black" varieties such as Bing are usually picked when fruit turns a solid bright red. Such fruit will turn dark-red to black during its 5 to 8 days transit to eastern markets. Fruit transported rapidly by air or to nearby markets can be harvested at a



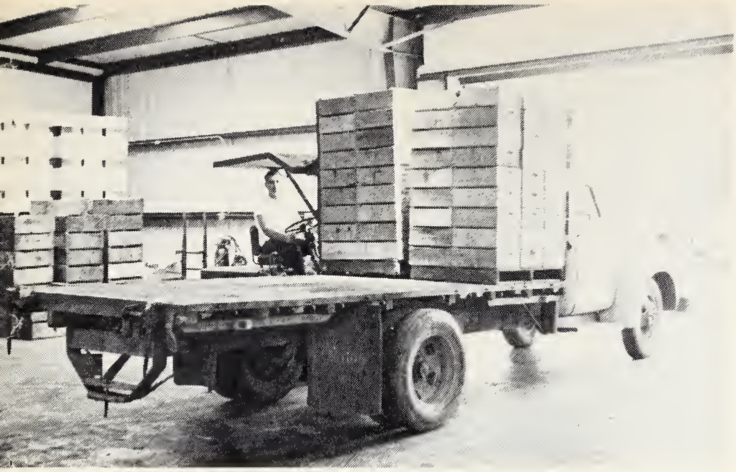
Effect of warm air and sunlight on cherry fruit temperatures at various positions within a box. Shaded cherries remain considerably cooler than exposed cherries, even though they warm up as the surrounding air temperature increases. Wind accelerates fruit warming when air temperature exceeds that of the cherries.

darker color, thus allowing its flavor to develop further on the tree.

Fruit must always be handled gently. Special care is needed to pick cherries with stems attached and without damaging the fruiting spur. If too many cherries are grasped at one time, the fruit may be squeezed and bruised. Decayed and damaged fruit should be discarded during picking. Fruit is normally picked into buckets which are then emptied into wooden field lugs. Bruising and damage must be avoided when filling buckets and transferring fruit to field lugs. Padding the bottom of buckets reduces fruit injury. Overfilling of lugs can result in fruit crushing when lugs are stacked.

Because of their dark color, cherries absorb heat rapidly when exposed to the sun and will soon be warmer than the

Filled cherry boxes should be stacked in the shade, and the top box should be covered. Harvested fruit should be transported to packing house or cooler soon after picking to avoid being warmed in orchard.



Picked cherries should be protected from exposure to sunlight and wind as much as possible. Unloading inside the packing house helps protect fruit.

surrounding air. Thus, cherries must be protected by stacking filled lugs in the shade and covering the top box immediately. If shaded fruit remains in the orchard, it may become exposed to direct sunlight later in the day. Moisture loss and subsequent fruit shrivel will result from exposure of harvested cherries to warm, dry, field conditions. With air movement, the temperature of the shaded fruit will quickly approach that of the surrounding air. Therefore, cherries should be removed from the orchard as soon as possible after picking even if they are well protected.

To minimize field delays there should be frequent deliveries of small loads of fruit. Cherries should be delivered to the packing shed on a properly suspended vehicle moving at a moderate speed and with reasonable care taken to prevent bruising, unnecessary warming, and excessive moisture loss. Air suspension on vehicles is best for fruit transit, but a good spring suspension system is satisfactory especially if tire air-pressure is reduced. The extent of fruit warming and moisture loss during transit depends on air temperature and velocity and the time in transit. At normal transit speeds both fruit warming and moisture loss can be high; weight losses of 1.5 per cent have been measured in exposed portions of a load during a transit period of less than 1 hour.

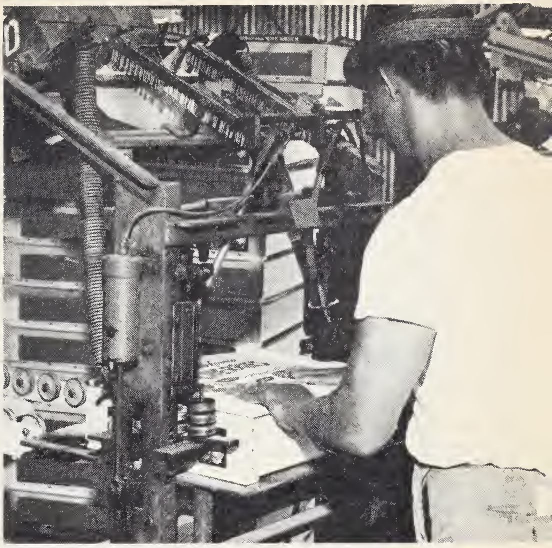
Limited observations indicate that covering a load with wet canvas just prior to transit may reduce moisture loss and delay fruit warming. (Fruit near the top of a covered load responded approximately like fruit in the center of an exposed load with regard to warming and moisture loss.) To avoid any "heat trap" effect, the covered load must not stand in the sun for prolonged periods. Covered vans may be desirable for long hauls if sufficient ventilation is provided to prevent accumulation of heat during transit. A shaded unloading area at the packing house also helps protect fruit.

CHERRY PACKING PROCEDURES

Most cherries are loose-packed (loosely random-filled) into shipping lugs with only a limited amount of face-packing (hand-placing the top two layers in rows) for special markets. In most packing lines the fruit is dumped on conveying

Top left: At most packing houses, cherries are dumped on conveyors and hand-sorted for defects and off-grade fruit. Top right: Stem cutters (rotating circular saws) divide clusters of cherries into individual fruit (with stems attached) to facilitate sizing. Bottom left: A water spray (often containing fungicide) is used to reduce friction during sizing, thus lessening incidence of injury. Bottom right: Diverging-roll sizer commonly used for sizing cherries.

belts, moved past blowers which remove leaves and trash, and then passed through stem cutters (rotating circular saws or knives) which divide clusters into individual fruit with stems attached to facilitate mechanical sizing. A diverging-roll sizer is commonly used, and a water spray is applied to reduce friction between fruit and rolls, thus lessening the incidence of injury. Hand-sorting is done at various points on the packing line to eliminate injured, immature, decayed,



Above: Lidding is usually the final step in packing, after which the fruit is cooled and shipped.

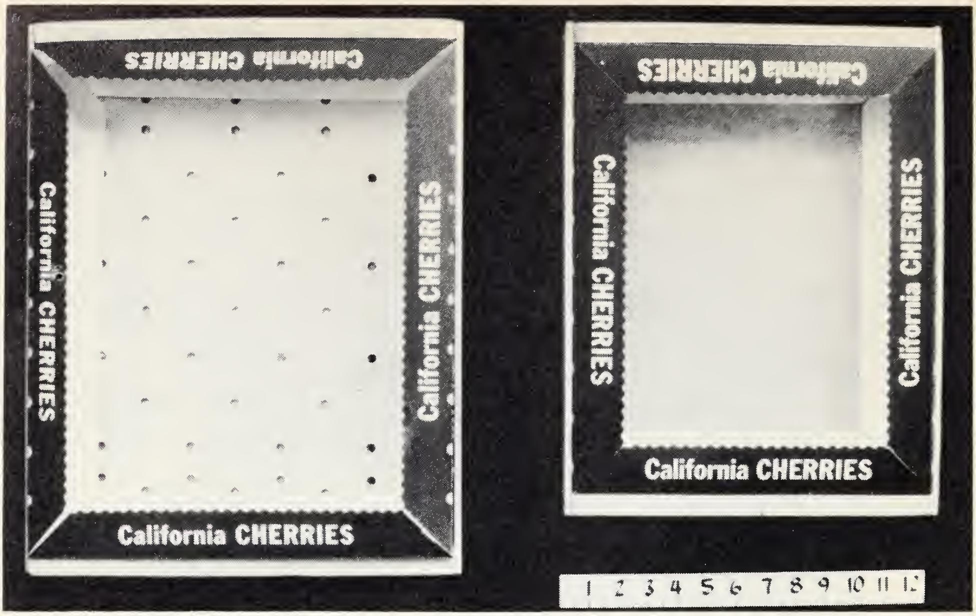
Left: After additional hand sorting, cherries are loose-filled into lugs.

and other defective fruit. Fungicides are often applied during the packing operation. Shipping containers are then filled with fruit to a uniform net weight and the containers are lidded.

Cherries are adaptable to tight-fill packing, which consists of random filling of containers with fruit to a constant weight, settling this fruit by carefully controlled vibrations, applying a top pad, and firmly fastening the lid (Mitchell, *et al.*, 1968*a*). The resulting tight pack and slight pressure from the pad prevents fruit movement and reduces vibration injury during transit. Most cherry packing lines can be easily adapted to this method. Because this system must be carefully applied to avoid introducing other injury problems, shippers should explore tight-fill packing cautiously before making any major conversion.

The standard shipping container for California cherries is the Calex lug—a wooden box 3¾ inches deep, 13½ inches wide, and 16⅛ inches long, used for the 18- to 20-pound cherry loose-pack. Face-packing is generally done in a Campbell lug, which is 4 inches deep, 11½ inches wide and 14⅛ inches long. Corrugated containers are in limited use, especially for air shipments since their lighter weight is an advantage. The wax coating used on some corrugated containers can help protect fruit from moisture loss.

The wax coating can also slow the penetration of moisture into the corrugated board, and thus aid in maintaining



Two wooden shipping containers used for cherries. The Calex lug (left) is the common shipping container and the Campbell lug (right) is for face packing.

the rigidity of the container. Corrugated containers must be constructed to provide sufficient stacking strength to protect the fruit during a normal marketing period under high humidity conditions.

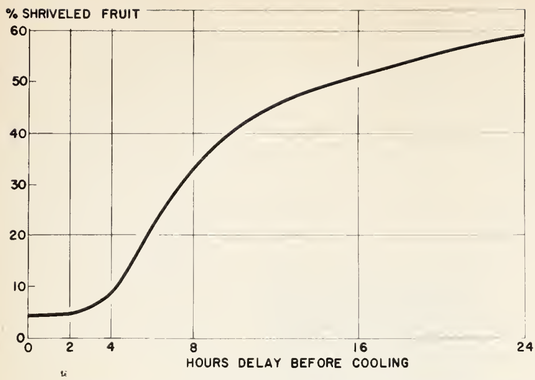
Although most cherries are packed to depths of 4 inches or less, recent studies indicate that a 6-inch depth could safely be used. Although there is considerable latitude in the depth for cherry containers, fruit damage does increase at depths greater than 6 inches. Therefore, a container could be designed with a greater depth and smaller horizontal dimensions to hold the same amount of fruit as the present lug—the smaller top surface would reduce top bulge and subsequent fruit loosening and damage.

In some states, cherries are packed in sealed polyethylene liners within the shipping containers. These liners have been reported to reduce decay and preserve stem freshness and fruit brightness (Gerhardt, 1956), but in California limited observations suggest that such liners may intensify fruit rotting. If liners are used they must be opened before the fruit is warmed to avoid oxygen starvation and fermentation of the fruit. They have not been commercially accepted in California and are not recommended.

PROPER COOLING IS ESSENTIAL

Fruit should be cooled as soon after harvest as possible to minimize deterioration. Delays of more than 24 hours without cooling have been observed in some commercial operations. Even holding noncooled cherries overnight in the packing house can cause serious deterioration, including fruit softening, stem darkening, decay, and increased moisture loss.

Studies have shown that water loss



Delays of more than 4 hours between harvest and cooling caused increased fruit shrivel. Following initial delays, cherries were held for 8 days at transit and marketing temperatures before shrivel evaluations were made.

occurs most rapidly during the first 8 hours following harvest, and then slows somewhat. The amount of shriveled fruit increased from 8 per cent after 4 hours delay to 33 per cent after 8 hours delay between picking and cooling. These results demonstrate the need for rapid fruit handling and cooling.

In California, sweet cherries are normally packed before cooling; however, if excessive packing delays are anticipated, fruit should be cooled prior to packing. Some warming will occur during packing, but it can be minimized by packing rapidly and immediately returning packed fruit to the cooler. Air conditioned packing facilities can lessen fruit warming.

Cherries should be cooled rapidly and thoroughly. While 40°F is often the goal for commercial coolers, studies show that physiological activity is slowest just above the freezing point of the fruit and that growth of rot organisms is slowed and moisture loss reduced at temperatures near 32°F. Sweet cherries have been reported to freeze at approximately 29°F (Whiteman, 1957), although the freezing point can vary with variety, growing conditions and maturity. While 32°F is considered safe for sweet cherries, the thermostat setting for any cooling room will depend upon the lowest temperature reached during cycling of the refrigeration system.

High air velocities are best for effective cooling, but will cause rapid and continuous water loss from fruit if maintained during subsequent holding periods. Once fruit is cold, air velocity need be only high enough to remove heat produced by fruit respiration and outside air leakage into the room. Thus, if cherries are to be held after initial cooling, fan controls are needed to reduce air velocity or the fruit must be moved to a holding area having a low air velocity.

COOLING METHODS

Cooling methods are a detailed subject and are only briefly covered in this circular. More information on the subject can be found in a publication by Guillou (1960).

Room cooling. This is accomplished by exposing fruit (usually after packing) to circulating cold air. This is the most commonly used method for cooling cherries and allows fruit to be cooled and held without rehandling.

Room cooling has several limitations. Fruit in standard room coolers may not reach 40°F even after 12 hours, and cherries, being highly perishable, may deteriorate appreciably during such slow cooling particularly if they are initially very warm. This relatively slow cooling may cause delays in loading or result in warm fruit being loaded for transit. Periodic introduction of warm cherries into a room containing cool fruit can cause fluctuations in temperature and relative humidity which can further slow cooling and add to deterioration problems. Uniform room cooling is dependent upon

Cherries usually are cooled in large rooms. The cooling rate of fruit in such rooms is relatively slow and so appreciable deterioration can occur during cooling.

adequate air circulation to remove warm air from around the fruit; therefore, containers must be spaced to allow for such circulation. Some fans should be operated even when people are working in cooling rooms.

The venting built into containers can have an important effect on cooling rates by influencing contact between fruit and cold air. A comparison between corrugated containers with 5 per cent side venting and the Calex lug showed cooling patterns to be similar. Thus, room cooling can be equally effective for both containers provided each is adequately vented and spaced for air circulation.

Cooled cherries should be protected from rewarming. The cooling room should be managed so that cold air passes over cooled fruit before contacting any warm fruit that has been introduced. Excessive traffic in and out of the room should be avoided, and when doors are open the room should be protected from heat leakage through the use of air barriers, such as swinging doors or "air curtains." Air curtains (which consist of an air flow directed across the door opening) can be useful in reducing heat leakage provided they are protected from wind.

Forced-air cooling. This method also circulates cold air, but in addition utilizes differential air pressure to direct air through containers and around the fruit, rather than around the outside of containers. The speed of forced-air cooling can be regulated by varying the volume and static pressure of air used in the system.

Forced-air cooling can be accomplished in one-sixth to one-eighth the time required for room cooling. Because forced-air cooling is rapid, there is greater opportunity for complete and uniform fruit cooling; this is especially important for highly perishable commodities like cherries, which usually are shipped immediately after cooling. If the system is properly designed, forced-air cooling should not hinder other packing or handling practices. (Existing room coolers can often be converted to forced-air cooling with a small additional investment.)

Forced-air cooling has some limitations. Additional handling of containers may be needed if the fruit is to be held after cooling. Containers must be vented, and air flow through the pack must not be impeded. As the number of tiers of containers (distance of air flow) is increased, the pressure differential needed to force air through the containers becomes greater and cooling becomes less efficient.

A comparison of forced-air cooling and room cooling—forced-air cooling within 4 to 8 hours, and room cooling within 14

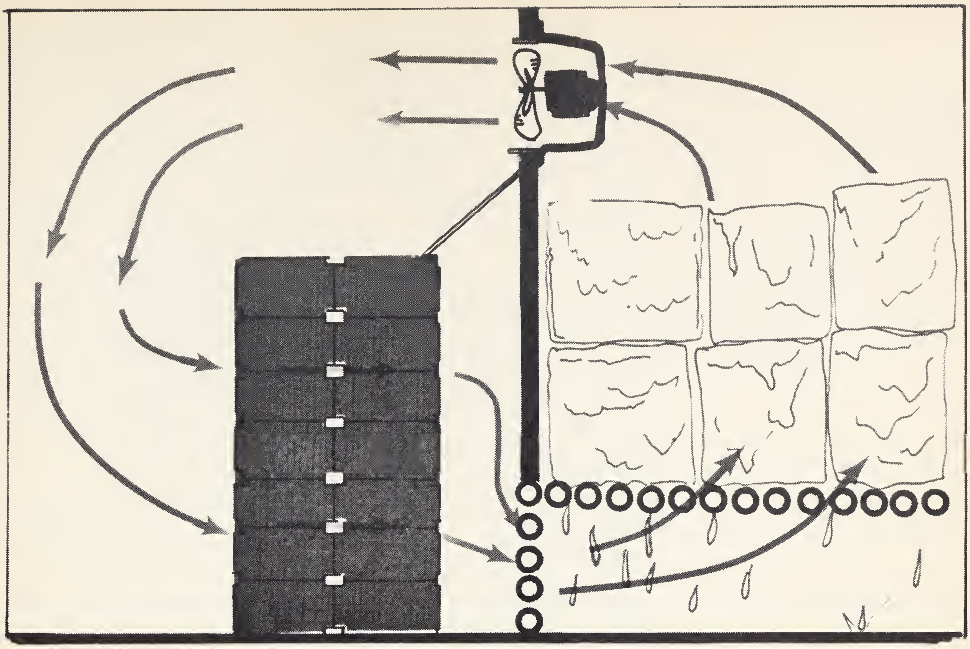


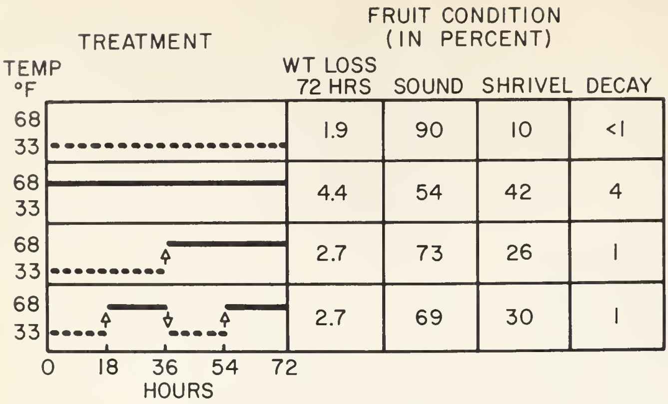
Diagram of air pattern for a forced-air cooler. Forced-air cooling utilizes differential air pressure to direct cold air through vented containers and around fruit. Such cooling can be done in only one-sixth to one-eighth of the time required for room cooling.

to 20 hours of harvest—showed an 85 per cent greater weight loss for room-cooled cherries; shrivel also was less severe in forced-air-cooled fruit. These results indicate a considerable advantage for forced-air cooling of cherries.

Hydrocooling. This method utilizes moving cold water to cool fruit rapidly. Sufficient movement of cold water over cherries so as to contact as much fruit surface as possible is necessary for rapid uniform hydrocooling. Potential benefits include speed of heat removal and reduced weight loss, but these benefits may be offset by the danger of spreading decay organisms as fungal spores accumulate in the water. Also, it is often difficult to maintain water temperature low enough for adequate cooling, especially during peak harvest periods (although insulating the hydrocooler can improve its efficiency). Fruit pitting has also been reported to be associated with hydrocooled cherries. Because of these problems hydrocooling of cherries should be undertaken with utmost caution.

RAPID FRUIT MARKETING

The importance of cooling cherries before the normal 5- to 8-day surface transit to eastern markets is generally recognized, but some fruit handlers have questioned the value of cooling when the time from harvest to market is only 2 or 3 days (as, for example, in air transit or when fruit goes to local markets). With these shorter times, facilities for maintaining constant low temperatures are often lacking, and some fruit handlers believe that cherries will deteriorate more rapidly if cooled and subsequently rewarmed than if not cooled at all.



Effect of shipping and holding temperatures on rapidly marketed sweet cherries. Top broken line indicates a continuous 33° F temperature for 72 hours; top solid line indicates the same for 68°F. Alternating temperatures are shown in each of the 2 lower spaces. Per cent sound (good) fruit decreases with longer exposures to warm temperature.

Studies of the effects of various combinations of cold and warm temperatures over a 72-hour period following harvest have verified the need for cooling, even though this is a relatively short time for marketing cherries. In these studies, moisture loss, decay, and shrivel were least for cherries held continuously cold, and greatest when fruit was constantly warm. When cold and warm temperatures were alternated, results were intermediate. A comparison of these combination treatments indicated that deterioration was related to the total exposure to warm temperatures rather than to the pattern of that exposure. These studies clearly indicate that preservation of cherry quality is dependent upon maintenance of a continuous cool temperature (near 32°F), even when the time from harvest to consumer is only 3 days. If constant low temperatures cannot be maintained, cherries should be cooled whenever possible, because cooling followed by rewarming is better than no cooling at all.

FRUIT TEMPERATURE MEASUREMENT

To assure maintenance of quality, handlers should regularly measure and record fruit temperatures throughout the marketing sequence. A sampling procedure should be designed that will ensure that fruit is not inadvertently shipped without adequate cooling. In addition to the immediate protection provided by such a program, temperature records can aid shippers in identifying some of the causes of poor quality or condition of fruit on arrival at the market, and they also can be useful in determining cooling patterns for the cold room. Temperature measurements should be taken during loading of each lot of fruit to make this program effective.

Fruit temperature cannot be accurately determined by measuring the air surrounding the cherries, nor will fruit temperatures at points of most rapid cooling (such as the top or edge of containers) provide an accurate measure of cooling throughout the stack. For accuracy, readings in fruit flesh must be taken in the center of boxes located in the slowest cooling positions in the stack, pallet, or room. Temperatures can vary greatly within a single stack of containers. In one test, cherries in the top box cooled to 40°F in about 4 hours, while fruit in the center of the same stack took approximately 8 hours to reach that temperature. Similar differences were noted between outer and inner fruit in the same container.

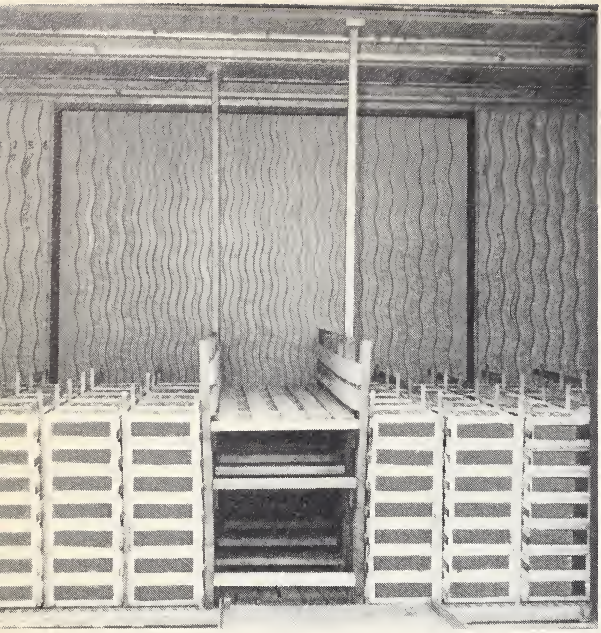
To obtain accurate temperatures, the pointed end of the thermometer should be inserted in one of the cherries in the center of the container.

LOADING AND TRANSPORTATION

Cherries must be loaded for transport to market so as to provide protection from rough handling and facilitate temperature management. Personnel should be trained and supervised to carefully handle fruit during loading, as warming or injury can accelerate deterioration. The transport vehicle should be thoroughly cooled before loading. A refrigerated loading dock adjacent to the cold room, with curtains or tunnels attached to the transport vehicle, will reduce warming of the fruit. After loading, the car (or truck) doors should be closed and the vehicle's refrigeration system thermostatically operated until unloading begins.

Most cherries are shipped by rail or truck in vehicles equipped with mechanical refrigeration designed to maintain fruit temperature and not to cool. Therefore, fruit should be thoroughly cooled to 32°F before loading. Thermostats in transit vehicles should be set to maintain the lowest safe temperature, without freezing fruit during cycling of the refrigeration system. For example, if the temperature in the transport vehicle fluctuates ± 2°F from the thermostat setting, then 34°F might be safe.

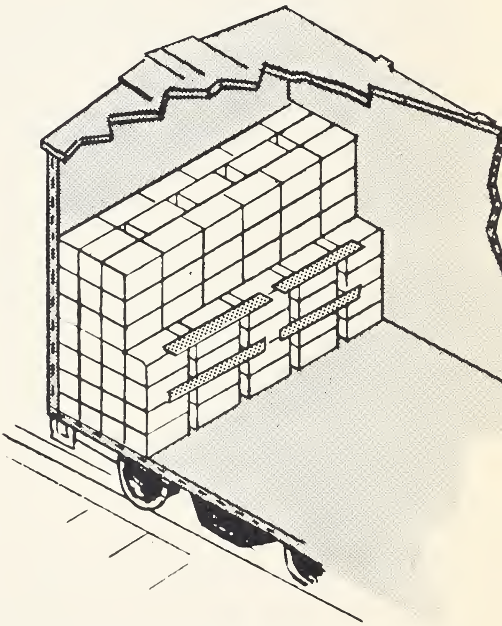
Wooden lugs require strip or block dunnage or other special loading procedures to immobilize the containers while providing space for air circulation through the load. To provide the same combination of immobilization and air circulation for corrugated containers, a new loading pattern called the "solid/spaced" load was developed (Mitchell, *et al.*, 1968*b*). This pattern consists of alternating tiers of tightly stacked and spaced containers. The tightly stacked, or solid tiers, provide load stability and the spaced tiers allow air circulation through the load (to remove heat produced by fruit respiration). Angle strips of wax- or resin-treated corrugated board must be securely stapled to spaced containers to hold them in place; corrugations should parallel the length of the



Left: Refrigerated rail car loaded for shipment (except for inclusion of dry ice in the center brace). Right: Truckload of cherries being braced for shipment.

strips. When this method is used, every cherry in the load is within 1 foot of an air duct or wall.

Dry ice at 1000 to 1200 pounds per vehicle is often used in the transport truck or rail car. It may be placed in a paper-lined crib in the center brace of a rail car, or in several racks over the top of a truckload of cherries. The dry ice is placed in the vehicle just before the doors are closed, and the paper covers are usually left on most of the blocks to slow sublimination. The primary purpose of this treatment is to raise the carbon dioxide concentration in the vehicle. Studies have shown that cherries will tolerate fairly high concentrations of carbon dioxide for short periods. Concentrations of 10 to 20 per cent carbon dioxide are safe during transit periods up to 7–8 days and will slow deterioration of fruit and retard growth of decay organisms. Caution should be taken in using dry ice when cherries are loaded with other produce, as elevated levels of



Solid-spaced loading pattern, showing tiers of solid-loaded (tightly stacked) containers alternated with tiers of spaced containers. Shaded area is cut-away rail car.

Igloo (sometimes used in air freight) of cherries being loaded into a refrigerated truck for transit to airport.

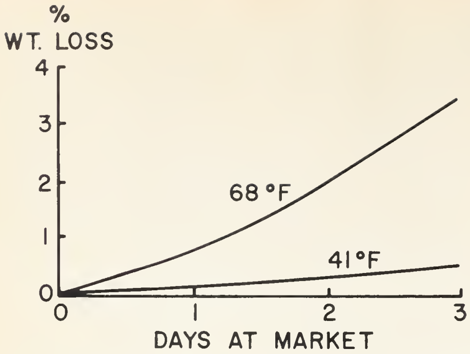
carbon dioxide, even for short periods, can damage certain other commodities. How effectively carbon dioxide concentration can be maintained depends upon the air tightness of the transport vehicle. Earlier tests indicated that desired concentrations could be established in 3 to 4 hours, and maintained for several days, but this period may be extended with modern equipment.

In recent years an increasing volume of cherries has been transported by air, but despite much greater speed total transit time can still be sufficient to cause serious deterioration of warm fruit. Fruit may be in the aircraft only about one-third of the total transport period. While refrigeration is usually not possible in the aircraft, it should be provided during surface transit and holding periods at each end of the trip. The time that the fruit is out of refrigeration, whether on the aircraft or at the airport, must be minimized to prevent excessive warming.

Sweet cherries may develop off-flavors when shipped or stored with other commodities having strong odors, so contact with such commodities must be avoided. Transport vehicles or cold rooms that retain a strong odor from recent painting, varnishing or other causes, should not be used for cherries.

TERMINAL MARKET HANDLING

As the cherries move through distribution channels and into terminal markets, they become older, riper, and more subject to damage. Thus, proper handling becomes even more critical. Keeping fruit at cool temperatures at terminal markets is the only practical means of minimizing self-destruction, moisture



Effect of refrigeration after transit on weight loss. Zero points indicate where temperature measurements were started during the marketing period after holding sweet cherries at a transit temperature (33°F) for 7 days. Nonrefrigerated (68°F) cherries lost weight at approximately 6 times the rate of refrigerated (41°F) fruit. This difference would have been even greater had the refrigerated temperature been 32°F rather than 41°F.

loss, and decay. Too often, cherries are exposed to relatively high temperatures during unloading, warehouse handling, and transit to the retail store, after which they are often never recooled; under these conditions excessive fruit loss can be expected.

Proper temperature management practices in wholesale and retail markets should include keeping cherries as near 32°F as possible without freezing the fruit, avoiding delays which keep fruit out of refrigeration, and recooling fruit quickly if it warms. Refrigerated transit from warehouse to retail stores and closely controlled loading and delivery schedules should be provided. Refrigerated retail displays should be used (if this is not possible, only a few hours' supply of cherries should be displayed at one time).

PUBLICATIONS MENTIONED IN THIS CIRCULAR

Davis, C. S., *et al.*
1972. Pest and disease control program for cherries. U. C. Agr. Exp. Sta. Ext. Ser. Cir. (See current edition.)

Gerhardt, Fisk, Harold Schomer and T. R. Wright.
1956. Sealed film lug liners for packing Bing cherries. USDA, AMS-121.

Guillou, Rene.
1960. Coolers for fruits and vegetables. U. C. Agr. Exp. Sta. Bul. **773.**

Mitchell, F. G., N. F. Sommer, J. P. Gentry, Rene Guillou and Gene Mayer.
1968*a*. Tight-fill fruit packing. Calif. Agr. Exp. Sta. Ext. Ser. Cir. **548.**

Mitchell, F. G., G. Mayer and C. H. Campbell, Jr.
1968*b*. Solid/spaced, a new carloading pattern for tight-fill packed fruit. Calif. Agric. **22** (12) :2–5.

Whiteman, T. M.
1957. Freezing points of fruits, vegetables and florist stocks. USDA Marketing Research Report No. 196.

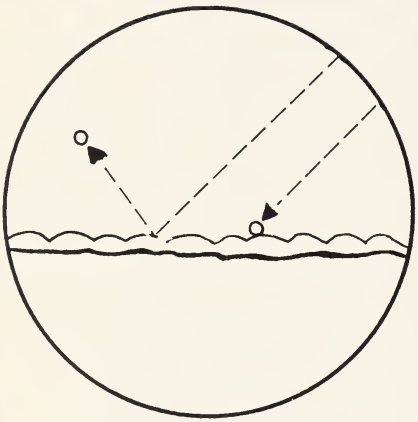
Co-operative Extension work in Agriculture and Home Economics, College of Agriculture, University of California, and United States Department of Agriculture co-operating. Distributed in furtherance of the Acts of Congress of May 8, and June 30, 1914. George B. Alcorn, Director, California Agricultural Extension Service.

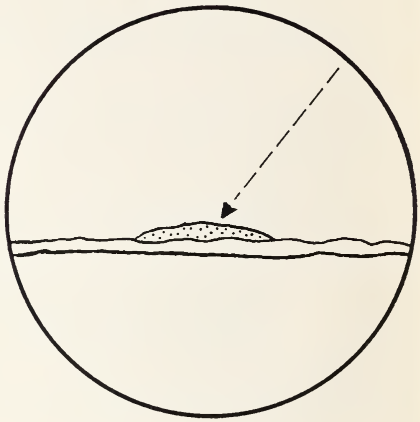
11½m-3,'72 (P9329L) VL

141

If a photograph won't show it...

draw a picture





That, in short, is what the authors and editors of our agricultural publications are urged to do. The photo above shows a method of applying a weed-killing spray. The drawing shows in detail why the spray droplets will select out the weed and kill it, but not affect the grass in the turf.

When possible we attempt to provide publications that will enable farmers, home gardeners, processors, and others in the agri-business community to put into good use the knowledge gained by research.

Write for a catalog of titles. You may find some of them quite interesting.

Agricultural Publications · University of California · Berkeley, California 94720